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Full Length Research Paper

Effects of adding dry gluten powder to common wheat flour on cooking quality of an Algerian homemade pasta, *Rechta*

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The purpose of this study was to determine the effects of adding dry gluten powder on the cooking quality of an Algerian homemade pasta called *rechta*. The experiment was carried out with two commercials common wheat flours (flour I and II), enriched with 2 and 4% (w/w) dry gluten powder additives. For comparative objects semolina was used. The gluten was extracted by lixiviation from commercial flour, different from those used in pasta production, then dried and ground. Obtained dry gluten powder was characterized by its ash and protein contents. Results show that *rechta* produced from semolina had longer cooked time, highest cooked weight and the lowest cooking loss than *rechta* produced from common wheat flours or common wheat flours enriched with dry gluten powder. *Rechta* made from common wheat flour (I) recorded almost the same cooking time as *rechta* made from common wheat flour (II). *Rechta* made from common wheat flours (I and II) had very close cooked weight and cooking loss. The addition of dry gluten powder to common wheat flours reduced cooking loss of *rechta*; improved its firmness and decreased its stickiness judged by a sensory test.

Key words: Homemade, *rechta*, flour, semolina, dry gluten powder, cooking quality.

INTRODUCTION

The Algerian's love for homemade pasta and other durum wheat products far outstrip Algeria's production of this foodstuff and Algeria still relies heavily on wheat imports from the international market to cover its consumption needs (Namoun, 2000). In spite of the 2009 record crop, Algeria imported about 1.24 million tonnes of durum wheat, 55% of its domestic utilization in the 2009/010 marketing year. However, in 2010/2011 marketing year, the country durum wheat purchases rose from 48% to 1.85 million tonnes (Hales, 2011).

The country's goal of durum wheat self-sufficiency still appears some way off. So to cut import of durum wheat, and reduce its alimentary bill, Algeria has to boost its grain production or Algerians must change their alimentary habit of a huge consumer of durum wheat. As grain production boost needs great efforts to be done in extensive agriculture which Algeria is not able to, instantly, the second possibility is the most realistic and feasible: if Algerians households use common wheat in the preparation of homemade products as this last and its milled products are cheaper.

This work is the beginning of a project that aims to thoroughly determine by investigation of food products made from durum wheat semolina and mobilizes the greatest use of this last. These products were manufactured by substituting semolina with common wheat flour. As texture of cooked pasta depends primarily on the quantity of protein and the properties of gluten protein (Feillet and Dexter, 1996; Marchylo and Dexter, 2001), we fortified common wheat flour with dry wheat gluten powder (vital wheat gluten).

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In the present work, we attempted to determine the effect of adding dry wheat gluten powder to commercial common wheat flour on the cooking quality of the Algerian homemade pasta, *rechta*. This last term designates both the homemade pasta product and the festive dish which is the main ingredient. According to a survey carried out by Boukezoula (2003), this pasta is one of the most consumed traditional pasta by Algerians that is why we are interested in it. *Rechta* was produced by hand in the laboratory according to the flow-sheet of artisanal production. The quality characteristics of flours and semolina were determined and the cooking quality of *rechta* samples. Due to the fact that *rechta* is not destined to be a commercial use, we intentionally omitted color assessment of the produced pasta and the used raw materials.

MATERIALS AND METHODS

Raw materials

Common wheat flours and durum wheat semolina used in this study were purchased from the local market (different sources). Dry gluten powder was obtained by extracting gluten by lixiviation from common wheat flour different from those used in the experiments and also was bought from a local market. Wet gluten were lyophilized then ground into fine powder. The resulting dry gluten powder is designed dry gluten powder flour (DGPF).

Methods

International cereal chemistry methods (ICC, 1995) were used to determine the following: moisture (method 110/1); total protein (method 105/2) and ash content (method 104/1). Gluten strength was evaluated by using gluten index (A.A.C.C., 2000). Wet gluten was determined according to A.A.C.C. 38-12 (A.A.C.C., 2000). Dry gluten was determined by drying wet gluten at 50°C over a night.

Rechta production

Rechta is homemade pasta prepared and consumed by a large part of Algerians households. It was prepared in the laboratory according to the flow-sheet of artisanal production described by Abbaz and Abd el-Aziz (1998). In a large bowl, we sifted 1000 g of semolina or flour, then we added salt (1%, on flour weight basis) and made a well in the centre. We added water slowly while mixing. *Rechta* was prepared with optimum water absorption to have uniform, smooth, and non sticky dough. The optimum water absorption was determined based on the appearance, sheeting and handling properties of the dough during the *rechta*-making process (Eyidemir and Hayta, 2009). Water was added to achieve the desired level of hydration; after which, we knead the dough energetically to form to a firm but slightly soft dough. Then we divided the dough into quarters and we rolled each quarter out to an approximately thickness of 2 mm on a surface dusted lightly with corn flour. After dusting dough sheets with corn flour, very lightly, we put them through the pasta machine on the lowest setting (to create thinnest pasta sheet). When all pieces have been put through the machine, we put them on the side to dry out for 30 min. Thereafter, we changed the setting or we added the attachment on the pasta machine to the one that cuts fine strands of the length of 15 cm, breadth of 1 cm and thickness of 1 mm. We then passed the sheets through the pasta machine and dusted each sheet with corn flour, which really helps the *rechta* strands not to stick together. We separated each *rechta* strands and scattered them on a clean cloth to let dry at room temperature with 12% moisture. Flours were enriched with 2 and 4% dry gluten powder in that ratio to the weight of each respective flour.

Cooking quality

Cooking time

Cooking time of *rechta* was measured as follows: *rechta* (5 g) were cut into 2 to 3 cm long then cooked in 200 ml boiling distilled water in a covered beaker. At every 30 s, a *rechta* strand was removed and pressed between two pieces of watch glass. Optimum cooking time was achieved when the center of *rechta* had no white core (Lucisano et al., 1984). The analysis was performed in triplicate for each pasta sample.

Cooking loss

This was measured by evaporating the cooking water to dryness. The *rechta* were rinsed with fresh distilled water, placed in a reweighed glass beaker, dried in an oven at 100°C for 10 h and weighed. Percentage of weight differences before and after cooking was calculated as cooking loss (A.A.C.C., 2000). The analysis was performed in triplicate for each pasta sample.

Cooked weight

Dry *rechta* (10 g) were broken into lengths of approximately 5 cm, then placed in 300 ml boiling distilled water and cooked for optimal cooking time. The cooked and drained *rechta* samples were weighed and the results were reported in grams. The analysis was performed in triplicate for each pasta sample.

Sensory evaluation

Sensorial quality is the aspect closest to consumer concerns. It is strongly linked to eating habits and traditions. According to Abbaz and Abd el-Aziz (1998) for Algerian consumer, *rechta* quality is based on performance and resistance that are mainly represented by textural characteristics, generally evaluated according to stickiness, firmness and bulkiness. The sensory evaluation was conducted on *rechta* cooked to optimum time. Samples were presented to a panel of 20 semi trained judges selected among students enrolled in a sensory evaluation course and have a good knowledge of *rechta*. Firmness, bulkiness and stickiness were evaluated by each panelist on a scale of 10 to 100: *rechta* with a total score ≤ 40 was poor or mediocre quality; *rechta* with a total score > 40≤50 was not completely satisfactory; *rechta* with a total score >50≤70 was fair; *rechta* with a total score >70≤80 was good; *rechta* with a total score >80 ≤100 was excellent (Cubadda et al, 2007).

Statistical analysis

Each analysis was performed in three replicates. All statistical

Table 1. Durum wheat semolina, common wheat flours and dry gluten powder quality characteristics.

Characteristic	Moisture (%)	Protein (% dm)	Wet gluten (%)	Ash (% dm)	Dry gluten (%dm)	Gluten index (%)
Semolina	14.30[a]	14.0.[a]	40.70[a]	1.00[a]	10.30[a]	80.33[a]
Flour(I)	12.50[b]	11.65[b]	32.10[b]	0.56[b]	8.18[b]	50.00[b]
Flour(II)	11.50[c]	11.52[b]	31.95[b]	0.60[c]	8.40[c]	40.00[c]
DGPF*	9.35	74.00	-	1.63	-	20.00[d]

[a]Values followed by the same letter in the same column are not significantly different from each other ($p<0.05$); *DGPF, dry gluten powder is originated from flour.

Table 2. Cooking properties of *rechta* made from commercial durum wheat semolina and commercial common wheat flours with and without DGPF.

Cooking property	Material						
	Rechta made from commercial durum wheat semolina	*Rechta* made from commercial common wheat flour (I)			*Rechta* made from commercial common wheat flour (II)		
		+ 0% DGPF*	+ 2 % DGPF	+ 4% DGPF	+ 0 % DGPF	+ 2 % DGPF	+ 4% DGPF
Cooking time (min)	15[a]	12.33[b]	13.66[b]	13.83[b]	12.50[b]	12.83[b]	12.50[b]
Cooked weight (g)	31[a]	25.00[b]	22.00[c]	21.60[c]	24.60[b]	21.66[c]	21.30[c]
Cooking loss (%)	4.35[a]	7.62[b]	7.63[b]	6.40[c]	8.50[e]	6.30[d]	6.01[d]

[a]Values followed by the same letter in the same line are not significantly different from each other ($p<0.05$); *DGPF, dry gluten powder is originated from flour.

analyses were conducted using excel (2003) program.

RESULTS AND DISCUSSION

Raw materials

The approximate analyses of the raw materials used in this study are shown in Table 1. Moisture content of the commercial durum wheat semolina and the commercial common wheat flours samples varied from 11.50 to 14.30% which is typical to the commercial milling products.

Semolina showed the highest protein content (14.00% dm). According to Simsson (2008), semolina with high protein content produced pasta that is strong and elastic. When cooked, it swells with low cooking loss. Usually, results of protein, wet and dry gluten contents are parallel, that is, as protein content increases, wet and dry gluten content also increases. Also semolina had the highest wet and dry gluten content.

In durum wheat, gluten index (GI) is an excellent indicator of gluten strength (Alamri et al., 2009). Commercial durum wheat semolina had significantly the highest GI (80.33%). Commercial wheat flours I and II had a lower GI (50.00 and 40.00%, respectively). The lowest gluten index (20.00%) was registered by the gluten dry powder. This would mean that semolina has very strong gluten while flours have relatively moderate strength of gluten. The dry gluten powder has weak gluten. A highly significant correlation is found between ash content and the brightness of semolina. For any given wheat, higher extraction produces darker semolina with higher ash content. So, relatively low ash content is desired for semolina in pasta processing. Semolina ash content (1.00% dm), was higher than flours ash content which is typical to commercial superior durum wheat semolina (Anonymous, 1997). Protein content of flours was 12.50 and 11.50% dm, respectively for flour I and flour II which is so similar to noodle flour (11% dm). Therefore, they were suitable for the production of *rechta* as this last looks like noodle especially as they have in addition a low rate of ash and adequate gluten index (gluten index : 50.00 - 40.00%). The dry gluten powder had the highest level of ash (1.63% dm) which can alter color pasta if added at higher doses.

Cooking quality

The cooking quality results for the seven samples of *rechta* that were obtained from commercial durum wheat semolina, commercial common wheat flours and from enriched flours are presented in Table 2.

Table 3. Cooking quality of *rechta,* made from commercial durum wheat semolina and from common wheat flours with and without DGPF, measured by sensorial test.

Sample	Characteristic			Total score[a]
	Stickiness	Bulkiness	Firmness	
Semolina	Almost absent	Almost absent	very good	78
Flour (I)	high	high	insufficient	31
Flour (I) + 2% DGPF	rare	rare	sufficient	59
Flour (I) + 4% DGPF	rare	rare	sufficient	55
Flour (II)	high	high	insufficient	25
Flour (II) + 2% DGPF	rare	rare	sufficient	57
Flour (II) + 4% DGPF	rare	rare	sufficient	60

[a]Means values. Panel numbers were 20. DGPF, Dry gluten powder is originated from flour.

To further carry out a good evaluation on *rechta*, it was necessary to determine its cooking properties such as cooking time, cooked weight and cooking loss.

Optimal cooking time was determined by the dis-appearance of white core in *rechta*. Optimal cooking time of *rechta* from commercial durum semolina was the longest (15 min). Sung and Stone (2003) reported that gelatinization was more slow at relatively high protein contents than at lower proteins contents. Commercial durum wheat semolina had the highest protein content which explains that its pasta had the longest optimal cooking time. *Rechta* produced from commercial common wheat flours and *rechta* produced from commercial common wheat flours fortified with dry gluten powder optimal cooking time varied from 12.50 to 13.83 min. Difference between optimal cooking time of samples made from commercial common wheat flours and commercial common wheat flour fortified with dry gluten powder was much lower than difference between optimal cooking time of samples made from semolina and samples made from flours or fortified flours. Cooking time was significantly affected by raw materials. It seemed that the addition of dry gluten powder had not a great effect on this parameter. Upon cooking 10 g of *rechta*, the cooked weight (31 g) of *rechta* made from semolina was within the expected value (Table 2) if we knew that generally a cooked pasta sample will weigh three times its initial weight (Anonymous, 2010). For the remainder samples, cooked weights varied between 21.00 and 25.00 g, and these values were lower comparatively to the sample made from semolina but they were far. It was also observed that the cooked weight disadvantageously decreased as the added dry gluten powder increased (Table 2). After cooking *rechta* made from the material without added dry gluten powder, its cooked weight increased up till 25.00 g. A 4% additive lead to a 21.30 g. It seemed that dry gluten powder decrease the cooked weight.

This test is best used in conjunction with firmness values to determine the cooking qualities of the pasta. A good sample should have a high cooked weight and high firmness values. Cooking loss is undesirable. Results in Table 2 showed that *rechta* sample made from semolina had the lowest cooking loss (4.35 %). The greatest cooking loss is registered by *rechta* sample made from commercial common wheat flour (II) (8.50%). Results show that addition of dry gluten powder reduces the cooking loss up till 6.1% case of sample made from flour (II) fortified with 4% of dry gluten powder. Alamri et al. (2009) reported that cooking loss of 8% or below is considered acceptable for good quality pasta. So if we excluded that *rechta* sample made from commercial common wheat flour (II); all *rechta* samples were of an acceptable good quality. However, the best one was the sample made from commercial durum wheat semolina. No doubt it because it had the highest protein content and a gluten of strong strength (Sisson, 2008).

Sensory evaluation

The sensory evaluation of cooked *rechta* (Table 3) showed that sample made from commercial durum wheat semolina had the highest score and judged as good by the sensory panel. Samples made from commercial com-mon wheat flours got the lowest score and were judged as of poor quality. The total score of samples, made from commercial flours fortified with DGPF, belong to the interval 50 to 70 and judged as far. It appeared from results presented in Table 3 that addition of dry gluten powder to commercial common wheat flours improve firmness and reduce stickiness and bulkiness.

Conclusion

The results obtained in our experiment show that semolina had the best analyzed features and had given a good pasta product as judged by panel. Cooking properties of *rechta* obtained from common wheat flours were not different. Addition of gluten powder decreased

cooked weight and cooking loss. Dry gluten powder additive improve the firmness of *rechta*, decrease in bulkiness and stickiness. *Rechta,* usually made from durum semolina, can be prepared from common wheat flour with a suitable protein content.

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